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Memorandum

To:	Eugene Radcliff, Washington State Department of Ecology
From:	Rob Leet and Kurt Anderson
cc:	Warren Snyder, Rayonier Inc.
Date:	October 24, 2011
File:	0137-018-02
Subject:	Addendum to *Focused Feasibility Study and Cleanup Action Plan, Former Sekiu Log Sorting Yard, Sekiu, Washington*

INTRODUCTION

This addendum to the *Focused Feasibility Study and Cleanup Action Plan, Former Sekiu Log Sorting Yard, Sekiu, Washington* (FFS/CAP; GeoEngineers, 2011) was prepared in response to the Washington State Department of Ecology's (Ecology's) preliminary comments on the proposed cleanup action for the subject property described in the FFS/CAP. The preliminary comments were shared by Eugene Radcliff of Ecology during a July 19, 2011 conference call with GeoEngineers.

During the July 19 conference call, Ecology identified two issues of concern:

1. The potential for remobilization of residual Bunker C fuel oil that will be left in place in soil below a depth of 6 feet following removal of Bunker C "hot spots" in the upper 6 feet of soil; and
2. The duration of confirmational groundwater monitoring following removal of Bunker C hot spots.

These issues are addressed separately below.

POTENTIAL REMOBILIZATION OF BUNKER C

The proposed cleanup action consists of removing Bunker C-contaminated soil that poses a potential risk to human health and terrestrial ecological receptors (i.e., Bunker C "hot spots") from the ground surface to a depth of 6 feet in the northern portion of the property. Soil below a depth of 6 feet containing contaminant concentrations greater than the cleanup levels established in the FFS/CAP will be left in place. An environmental covenant will be established to protect against potential future human/ecological exposures to this remaining soil contamination, and confirmational groundwater monitoring will be performed to confirm that the remedy continues to be protective of the offshore marine environment.

The remedial investigation (RI) conducted at the property (GeoEngineers, 2009) identified isolated areas of residual Bunker C in soil between 6 and 15 feet below ground surface (bgs). The RI results indicate that this residual Bunker C is discontinuous, highly viscous, and immobile. Scenarios that could potentially result in future remobilization or exposure to this residual Bunker C following completion of the proposed remedy are discussed below.

- **Disturbance of Contaminated Soil Below 6 feet bgs**

  Remobilization of Bunker C could occur as a result of future soil disturbance activities (e.g., excavation) below a depth of 6 feet in the northern portion of the property, where residual Bunker C will be left in place. The proposed cleanup action includes an environmental covenant to protect against potential future human/ecological exposures to this residual soil contamination. The covenant will specify that if soil below 6 feet bgs is disturbed subsequent to the cleanup action, the soil must be handled in accordance with a Soil Management Plan (SMP). The SMP will be included as an attachment to the environmental covenant and will identify specific contaminated soil locations and depths that will require special handling if disturbed. Appropriate soil management and disposal procedures for protection of human health and the environment will be detailed in the SMP. Accordingly, the environmental covenant will address the potential risk of residual Bunker C remobilization and exposure associated with future soil disturbance activities.

- **Sea Level Rise**

  Isolated pockets of residual Bunker C were observed in soil in both the saturated zone and the unsaturated zone during the RI (GeoEngineers, 2009). Since log sorting operations at the property ceased in the early 1970s, the observed Bunker C has existed in the subsurface for at least 40 years. Despite the presence of Bunker C in the saturated zone below the groundwater table, dissolved-phase Bunker C has only been detected in groundwater in one monitoring well (inland well MW-1). Liquid-phase Bunker C has never been detected in any monitoring wells.

  If the sea level were to rise in the future relative to present-day sea level elevations (as a result of global warming, for example), average groundwater elevations at the site could also rise due to the site's proximity to the shoreline. However, since residual Bunker C already exists at depths up to 8 to 10 feet below the elevation of the groundwater table at high tide (i.e., up to approximately 15 feet bgs), and since the RI and groundwater monitoring indicate that the residual Bunker C is immobile, a future rise in sea level would not be expected to result in remobilization of the Bunker C present in the saturated zone. Because the cleanup action will remove the residual Bunker C present in the unsaturated zone above the groundwater table, there will be no possibility that this Bunker C could become remobilized.

- **Earthquake**

  The subject property is located on the Washington coast in the Cascadia Subduction Zone, and thus can be affected by large earthquakes. During and/or following an earthquake that causes substantial ground shaking, liquefaction or sloughing of soils near the shoreline could potentially cause remobilization of Bunker C. Although the risk of earthquake occurrence cannot be mitigated or controlled, the potential for soil liquefaction and sloughing at the subject property is considered low, for the following reasons:

  - The risk of liquefaction is typically greatest in relatively large, thick, sediment-filled basins, river valleys, or coastal areas containing a significant amount of poorly-graded, loose, saturated sandy soils. The unconsolidated soils at the subject property occur in a relatively thin layer that extends from the ground surface to a depth of approximately 15 feet bgs. These soils are generally well-graded and consist predominantly of silt and gravel with variable amounts of fine sand. Very dense glacial till occurs below the unconsolidated soils at a depth of approximately 15 feet bgs. The saturated zone above the till is thin – on the order of a few feet to 10 feet thick depending on

the tidal cycle and the distance inland from the shoreline. Based on the observed soil characteristics described above, soils at the property are unlikely to experience significant liquefaction during an earthquake.

- The risk of sloughing is typically greatest in areas having significant relief and relatively steep ground slopes, with little or no vegetation or other stabilizing elements such as retaining walls and rock seawalls. The subject property is situated at a low elevation and is relatively flat and level; furthermore, the sloped shoreline is protected from erosion and sloughing by riprap armoring. Consequently, a large earthquake is unlikely to cause significant sloughing of shoreline soils at the property.

DURATION OF CONFIRMATIONAL GROUNDWATER MONITORING

The FFS/CAP proposed one year of quarterly groundwater monitoring to confirm that the cleanup action continues to be protective of marine surface water after the Bunker C hot spots are removed. Ecology has indicated that since the cleanup action will leave contaminated soil in place below 6 feet bgs, one year of quarterly groundwater monitoring is not sufficient to confirm long-term protectiveness. Accordingly, Rayonier proposes to modify the groundwater monitoring schedule as follows:

- In the first year following cleanup action construction, groundwater monitoring will be performed on a quarterly basis (four groundwater monitoring events).
- In second year following cleanup action construction, groundwater monitoring will be performed on a semiannual basis (two groundwater monitoring events).
- In the third through fifth years following cleanup action construction, groundwater monitoring will be performed on an annual basis (three groundwater monitoring events).

The confirmational groundwater samples will be obtained from a subset of the existing monitoring wells at the property – for example, one upgradient well, one well within the cleanup area, and two or more shoreline wells downgradient of the cleanup area. The samples will be submitted for chemical analysis of heavy oil-range total petroleum hydrocarbons quantified as Bunker C using Ecology Method NWTPH-Dx and carcinogenic polycyclic aromatic hydrocarbons using EPA Method 8270D/SIM.

After the fifth year of groundwater monitoring, the scope of further confirmational monitoring will be determined through discussions with Ecology.